UDC: 373.5.091.26:[616.98:578.834}-036.21(497.751)
373.5.091.26:[616.98:578.834(497.751)
Professional paper

COMPARING STUDENT SUCCESS BEFORE AND DURING THE PANDEMIC

Mirlinda Shaqiri [1], Lazim Kamberi [1], Merita Bajrami [1]

[1]*Department of Math, Faculty of Natural Sciences and Mathematics*
**Corresponding author e-mail: mirlinda.selami@unite.edu.mk*

Abstract
The purpose of this paper is to compare the success achieved in students before and during the pandemic, as well as the comparison between the two schools. Tables and graphs are used for data processing using Exel program. The research sample consists of a total of 106 individual high school students in the Tetovo region.
In this paper we will consider some applications of the chi-square test. The data for this research were taken from the electronic diaries of the monolingual high school Second Gymnasium "7 Marsi" - Tetovo and the bilingual vocational high school of economics "8 Shtatori" -Tetovo.
Through the results and data collected we try to show the success of students during and before the pandemic. We also compare the connection between two high schools in the municipality of Tetovo.

Keywords: Success, Pandemic, Hypotheses, Chi-squared test

1. Introduction

Given that the pandemic affected the whole world, it significantly affected the educational process, which is the purpose of this research.
The study describes a research with the help of chi-squared test. The issue is whether or not there is independence from each other. We will use this test of independence to determine the comparison between two high schools in the municipality of Tetovo. We pay special attention to the results achieved for each case separately.
The data for the high school "7 Marsi" -Tetovo and the vocational high school "8 Shtatori" -Tetovo are given with the following table:

Table 1. *Success of students before the time of the pandemic*

Schools	Macedonian language	English language	German language	Economics	Business	Total
"7 Marsi"	1,98	1,79	2,42	2,26	2,3	10,75
"8 Shtatori"	3,32	3,02	3,39	3,58	3,81	17,12
Total	5,3	4,81	5,81	5,84	6,11	27,87

The independence test is a comparison of the differences between the observed and expected values. In this test, we need to calculate the expected value using the total row and column from the table. The expected value for each of the possible results in the table can be calculated with the following formula:

$$Expected\ frequency = \frac{(Total\ row)\ (Total\ column)}{Total\ number\ of\ observations}$$

In the table above, we have calculated the sum (total) of the row which is 10.75, while the total of the column is 5.3; 4.81; 5.81; 5.84; 6.11 respectively. Using the formula, we find the

following expected frequencies for the possible results and by modifying the above table we obtain :

Table 2. *Expected frequencies for subjects before the time of the pandemic*

School / Subject	Macedonian language	Expected frequency	English language	Expected frequency	German language	Expected frequency	Economics	Expected frequency	Business	Expected frequency	Total
"7 Marsi"	1,98	2,04	1,79	1,86	2,42	2,24	2,26	2,24	2,3	2,36	10,75
"8 Shtatori"	3,32	3,26	3,02	2,95	3,39	3,57	3,58	3,59	3,81	3,75	17,12
Total	5,3		4,81		5,81		5,84		6,11		27,87

From the Table 2 we can calculate the chi-square statistics. We first create a hypothesis based on our research question. The null hypothesis is that there is not a large difference in student success between two schools. Therefore, the hypotheses can be defined as follows:
Null hypothesis :
$H_0: O = E$(There is no major difference in student success between the two schools)
Alternative hypothesis:
$H_a: O \neq E$(There is a big difference in student success between the two schools)
Using the Table 2, we calculate the degrees of freedom and chi-square statistics. The formula for calculating chi-square statistics is:

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

where O-is the observed frequency value for each event, while E-is the expected frequency value for each event.

Table 3. *Table for chi-square statistics before the time of the pandemic*

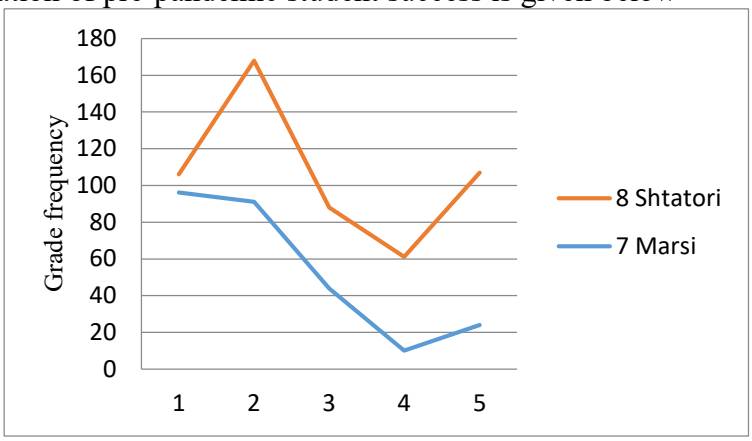
School/Subject	Macedonian language	Expected frequency	$\frac{(O-E)^2}{E}$	English language	Expected frequency	$\frac{(O-E)^2}{E}$	German language	Expected frequency	$\frac{(O-E)^2}{E}$	Economics	Expected frequency	$\frac{(O-E)^2}{E}$	Business	Expected frequency	$\frac{(O-E)^2}{E}$
"7 Marsi"	1,98	2,04	0,002	1,79	1,86	0,003	2,42	2,24	0,014	2,26	2,24	0,0002	2,3	2,36	0,002
"8 Shtatori"	3,32	3,26	0,001	3,02	2,95	0,002	3,39	3,57	0,009	3,58	3,59	0,00003	3,81	3,75	0,00096
Gjithsej	5,3			4,81			5,81			5,84			6,11		

$$\chi^2 = \sum \frac{(O-E)^2}{E} = 0{,}03419$$

Degrees of freedom can be calculated as follows:

$$df = (C-1)(R-1) = (2-1)(5-1) = 4$$

From the standard chi-square distribution table, we see that the critical value for the chi-square is 9,488 (with significance $\alpha = 0{,}05$). Since the chi-square value of 0,03419 is less than 9,488 we can conclude that there is no major difference in student success between the two schools. The graphical representation of pre-pandemic student success is given below



Graph 1. Student success before the time of pandemic

From the graphic presentation, we notice that the success of vocational high school students has higher success compared to other school.
In the following we see the success of students during the time of the pandemic.

Table 4. Success of students during the pandemic

School/Subject	Macedonian language	English language	German language	Economics	Business	Total
"7 Marsi"	3,17	1,96	3,15	2,75	2,74	13,77
"8 Shtatori"	3,55	3,3	3,92	3,98	4,09	18,84
Total	6,72	5,26	7,07	6,73	6,83	32,61

Similar to the above, we find the expected frequencies for each subject and then find the chi-square for student success during the pandemic. We first create the hypothesis that no difference is expected in student achievement during and before the pandemic.
Therefore, our hypotheses can be defined as follows:
Null hypothesis :
$H_0: O = E$ (no difference is expected in student achievement during and before the pandemic between research schools)
Alternative hypothesis:
$H_a: O \neq E$ (significant difference in student success during pandemic time is expected between the schools involved in the research).

Table 5. Expected frequencies and chi-square statistics for subjects during the pandemic

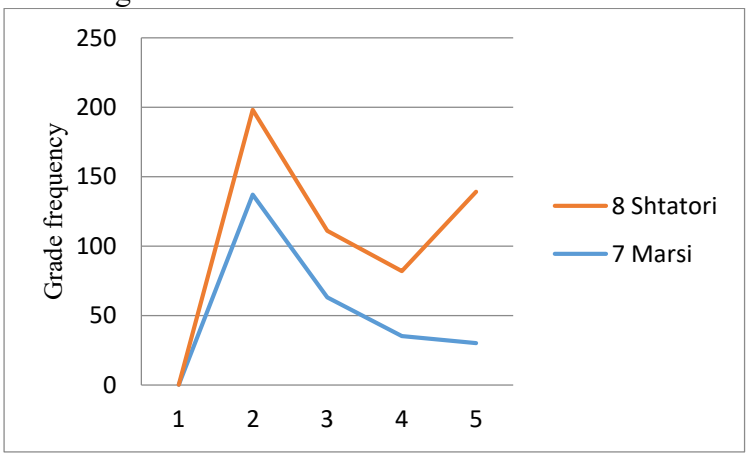
School/Subject	Macedonian language	Expected frequency	$\frac{(O-E)^2}{E}$	English language	Expected frequency	$\frac{(O-E)^2}{E}$	German language	Expected frequency	$\frac{(O-E)^2}{E}$	Economics	Expected frequency	$\frac{(O-E)^2}{E}$	Business	Expected frequency	$\frac{(O-E)^2}{E}$
"7 Marsi"	3,17	2,84	0,04	1,96	2,22	0,03	3,15	2,96	0,01	2,75	2,84	0,0028	2,74	2,88	0,007
"8 Shtatori"	3,55	3,88	0,03	3,3	3,04	0,02	3,92	4,08	0,006	3,98	3,89	0,002	4,09	3,95	0,005
Total	5,3			4,81			5,81			5,84			6,11		

$$\chi^2 = \sum \frac{(O-E)^2}{E} = 0{,}1528$$

In this case, the degrees of freedom are

$$df = (C-1)(R-1) = (2-1)(5-1) = 4$$

From the standard chi-square distribution table, we see that the critical value for the chi-square is 7,779 (with significance $\alpha = 0{,}05$). Since the chi-square value of 0,1528 is less than 7,779 we can conclude that no difference is expected in the success achieved by students during the pandemic and before it between the schools under research. The graphical representation of student success during the pandemic time is given below



Graph 2. Student success during pandemic

From the graphic presentation it can be seen that the success of students during the pandemic in both schools has increased significantly, which means that our hypothesis that no difference is expected in the success of students during the pandemic and before it between the two schools is not true.

2. Conclusion

Through the results and data collected we conclude that the success achieved by students during the time of the pandemic has a significant increase. Also, the comparison between the two schools shows that the vocational high school "8 Shtatori" has a higher success compared to the other school. For students of vocational high school of Macedonian ethnicity success is higher both before and during the pandemic.

References

[1] Llukan Puka, Hyrje në statistikën e zbatuar, Mediaprint, 2015, Tirana, Albania.
[2] Lazim Kamberi, Statistika e zbatuar, Tetovë
[3] Bruce L. Bowerman, Richard T. O'Connell (2003), Business Statistics in Practice. Miami University: 414-436
[4] L. Kamberi, Sh. Kameri, Sh. Ismaili: An Evaluation of the ICT Use by the Students of Tetovo Universities in Macedonia, JDCTA: International Journals of Digital Content Technology and its Applications, 2011
[5] Ch. Ch. Keong, Sh. Horani, J. Daniel: A Study on the Use of ICT in Mathematics Teaching, *Malaysian Online Journal of Instructional Technology*, 2005
[6] Narayanaswamy Balakrishnan, Vassilly Voinov, M.S Nikulin-2013, Chi-Squared Goodness of Fit Tests with Applications
[7] E. Vula: Hulumtimi në veprim: Udhëzime praktike për hulumtimet në klasë, Prishtinë, 2015